Support for Local Educational Expenditures by the Elderly
—Evidence from Japan—[*]

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Abstract

This study investigates the relationship between the elderly population and public educational expenditures at the kindergarten, primary school, junior high school, and high school levels in Japan. We applied the dynamic estimation method to data on local expenditures on education after the late 1990s, when aging negatively impacted educational expenditure in Japan. The estimation results indicate that the elderly are unlikely to support an increase in current expenditures that constitute a considerable fraction of payroll at any educational level. However, they display a positive attitude toward capital expenditures which mainly comprised construction costs for a relatively higher educational level.

Keywords : aging population, educational expenditures, local governments, components of educational expenditures, educational levels

JEL Classification numbers : H75, I28

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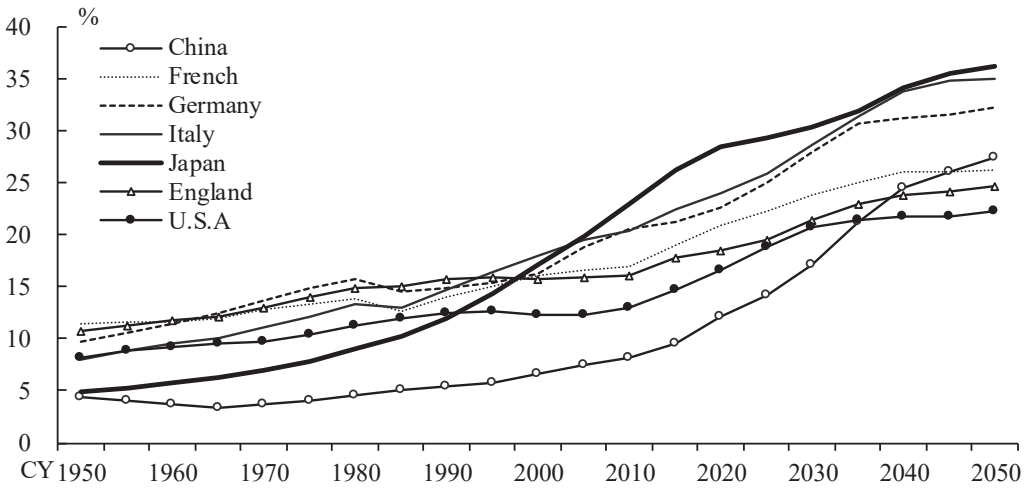
1. Background and objective

Japan's population is aging faster than any other developed country. According to the National Census, Japan's elderly population (aged 65 and above) will reach about 30% of all Japanese people in 10 years and 36% in 30 years. How will this rapid aging impact government expenditures? According to the median voter theorem, preferences for the elderly in government decision-making have had an increased impact on determining government expenditures, matching the aging population. While government expenditure is expected to increase in programs that provide many direct benefits for the elderly, such as medical expenses and pensions, supporting government expenditures for the younger generation will theoretically become difficult too, since such programs will not likely provide direct benefits for the elderly. This paper focuses on educational expenditures, which is intuitively thought to lack direct benefits for the elderly, and analyzes the impact of aging on such expenditures.



(Note1) The figures after 2020 are median estimated values.
(Source) United Nations, "World Population Prospects: The 2015 Revision Population Database."

Fig.1：Percentage of people over 65 years old (seven major countries)

To investigate the relationship between aging and educational expenditures, Miyaki and Kimura (2019) estimated Japanese prefectural data during the period 1975–2013. The paper is the first attempt in Japan to analyze every educational stage—from kindergarten to university—and shows differences in the impacts of aging on each stage during this period. In this paper, we develop the framework of Miyaki and Kimura (2019) and focus on educational expenditure categorized into two types: current spending or capital spending. Since the purpose of these two expenditure categories is different, elderly voter's preference toward them might be, too.

The proportion of elderly voters in Japan will steadily increase, with an attendant (expected) increase in the influence of their preferences in political decision-making. Therefore, understanding the positive or negative attitudes of the elderly toward educational expenditures, classified by type, will provide helpful information for local government officials deciding how to allocate limited public education resources. As far as we know, in the area of educational policy, there is limited research examining the influence of aging on educational expenditure focusing on its components, that is current and capital expenditures. In addition, we conduct a detailed analysis by applying dynamic perspective after carefully examining the data's characteristics.

2. Theoretical background and previous research

The impact of aging on educational expenditure is intuitively thought to be negative. That is, if the elderly are assumed to be egocentric, there would be support to increase social welfare and medical expenditures in regions where there is high proportion of the elderly, and less support for educational expenditure, since it provides little direct benefit for the elderly. On the other hand, Poterba (1998) and Harris et al. (2001), note five scenarios where the elderly are likely to support increased educational expenditure.

First, the indirect benefits of positive externalities from education extend across generations, reaching the elderly as well. When young workers improve technology and productivity through education, their wages increase, leading to increased tax revenues, which can be expected to enrich social welfare benefits. Second, the elderly might be altruistic. For example, if they benefit from consumption by their children or grandchildren, for example in the apparel industry and at department stores as "the six pockets," there are cases of relative generosity where the elderly will spend more on grandchildren. Third, the capitalization of the educational impact through an increase in value of a particular asset such as housing. In this case, if a person planning to purchase a house does not mind spending more in an area with a high-quality school, the elderly will no doubt support an increase in educational expenditures to maximize the asset value. Fourth, if elderly persons who do not want to pay taxes to enrich public education expenses move to regions where educational expenditures are low, educational spending in regions with lots of children is likely to remain high despite aging in the region. Fifth, the elderly think that public education is vital for children to adapt to life in society. This could include learning about aspects such as the duties of citizens and social norms through education that reduces the crime rate and stimulates economic activity.

In theory, the relationship between aging and local educational expenditure can be either positive or negative, and empirical analysis has so far provided no conclusive evidence either way. Many studies have found a negative relationship (Table 1). Ladd and Murray (2001), however, did not find any significant result. Hoxby (1998) analyzed the impact at the school district level in Massachusetts from 1900 to 1990, finding a positive relationship between aging on public educational spending. In Japan, Ohtake and Sano (2010) also found a positive relationship between aging and compulsory education expenditure before the 1980s. Miyaki and Kimura (2019) found that before the 1990s, the elderly tended to support local public expenditure especially for high school and university. After the 2000s, however, the cohort's preferences changed, and they have not been so willing to support such spending. The elderly even show a statistically significant negative attitude toward local public expenditures for kindergarten and the primary grades.

Table 1: Relationship between aging and educational expenses

Previous research	Area	Period	Relationship between aging and educational expenses
Poterba (1997, 1998)	USA・State	1960～1990	－
Hoxby (1998)	"USA・Massachusetts ・School district"	1900～1990	～Beginning of the 20th century：＋ from 1990：－
Ladd and Murray (2001)	USA・County	1970～1990	0
Harris et al. (2001)	USA・School district	1972～1992	－
Grob and Wolter (2007)	"Switzerland ・State／Territory"	1996～2002	－
Borge and Rattso (2008)	Denmark・Local government	1986～1996	－
Arvate and Zoghbi (2010)	Brazil・Local government	1991, 2000	－
Ohtake and Sano (2010)	Japan・Prefecture (Every 5 years)	1975～2005	～1985：＋ 1990～：－
Figlio and Fletcher (2012)	USA・School district	1970, 80, 90	－

(Note1) + and - indicate positive and negative sign of coefficients of estimated parameters, respectively. 0 indicate "not significant".

These previous studies offer insightful evidence. However, one point of view is not considered: the elderly's preference where expenditure could differ by components. Given severe financial difficulties and a declining birthrate, the elderly may be adverse toward tangible spending such as new construction or expansion of school facilities, but tolerate increases in intangible spending that can easily affect the quality of education. On the other hand, even though it falls under the category of capital spending, some spending for indispensable projects such as maintaining aging buildings and upgrading earthquake-resistant construction could be supported by the elderly or spent regardless of their preferences.

Some empirical research in the area of local government expenditures has often taken into consideration that point of view, analyzing expenditures by the components. For example, Miyazaki (2005) investigated the cost-reduction effect caused by municipal mergers, classifying public expenditures by categories such as current costs and personnel costs. He found a different result for the cost-reduction effect depending on the components of each expenditure. Differences in the cost-reduction effect do not always correspond to voter's preferences, since some expense items are relatively easy to cut, while others are not due to the rigidities or other characteristics of government spending. It is still possible, however, that government spending reflects a difference of a voter's preferences. Aoki et al. (2012) investigated compulsory educational expenditures classified by the components in Japan and surveyed their time-series trend, focusing on the funding source and intergovernmental relationships. However, they do not empirically examine the determinants of educational expenditures.

3. The data

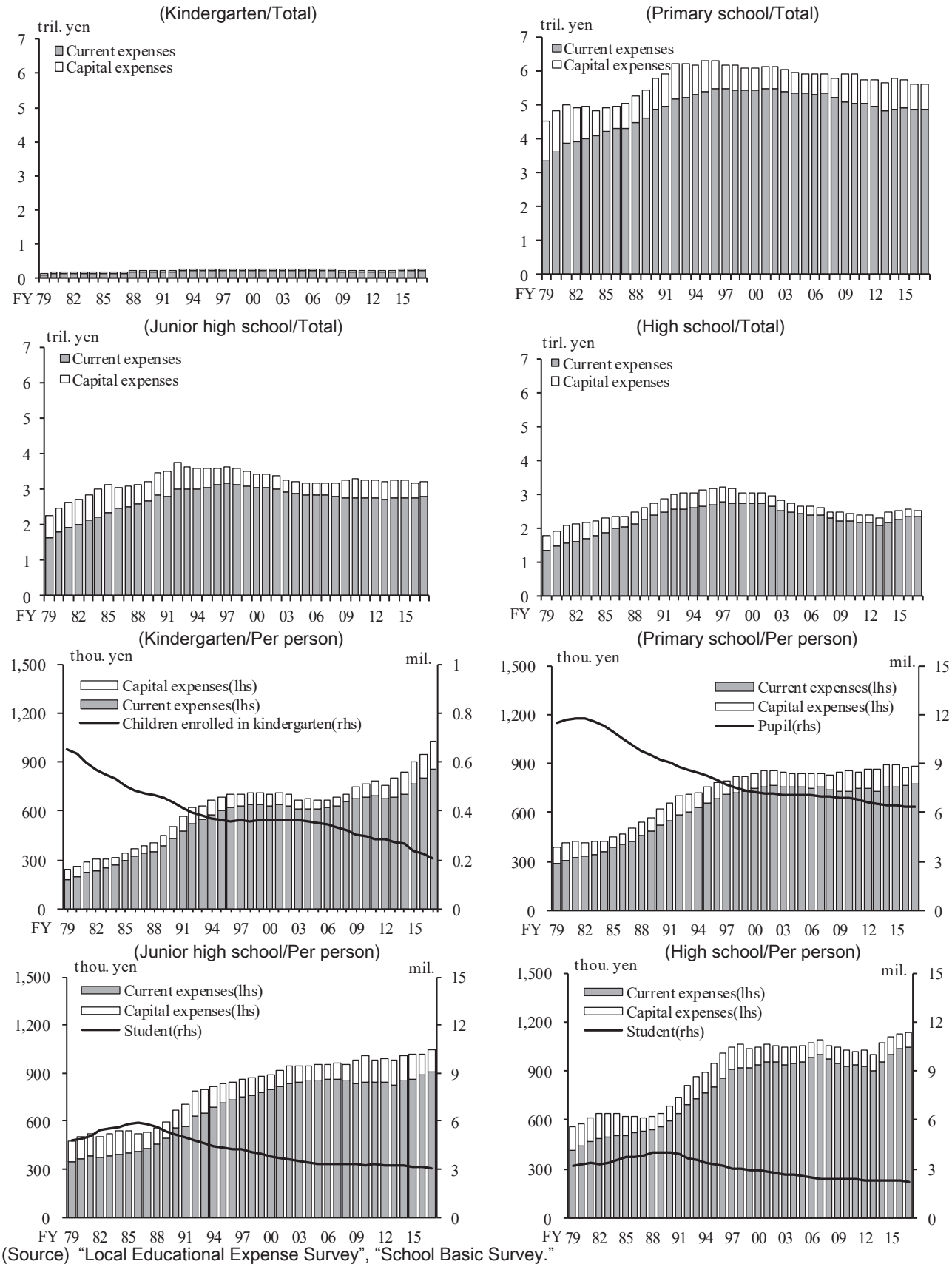
Pertaining to the financial source of educational expenditures, local governments, such as prefectures and municipalities, play a greater role than the national government. The Ministry of Education, Culture, Sports, Science and Technology's "Local Educational Expense Survey" reports that the proportion of educational

expenditure borne by national and local governments in Japan were 32% and 68%, respectively, in FY2016. These proportions consider a local allocation tax (LAT) to be local funds and calculate it by including the appropriated amount of tax allocated by local governments for educational expenditure, as the total expenditure borne by local governments. However, even if the appropriated amount of LAT is considered to be national government funds, the portion borne by local governments remains large and local public bodies have considerable discretion concerning educational expenditures. Thus, we analyze local level of educational expenditure.

Even when referring to educational expenditure as a single item, the coverage of such expenditures is diverse. According to the Ministry of Internal Affairs and Communications' "Local Public Finance Survey," educational expenditure can be categorized as: school expenses, general and administrative expenses, and social-educational expenses. In FY2017, their percent of educational expenditure was 84.2%, 6.0%, and 9.8%, respectively. School expenses refer to the cost of spending on school education activities at the "Article 1 schools," as defined in Article 1 of the School Education Act (1947), pertaining to levels from kindergarten to university. The direct beneficiaries of such school education are the students enrolled at each education level. General and administrative expenses include the costs required by the Board of Education and executive offices, educational work and private education institutional aid. Social education expenses include social-educational facilities such as libraries and museums, as well as the cost of social education activities. The direct benefits of general educational expenses and social-educational expenses cover a wide-range, from the students in private schools to users of facilities—including the elderly. Thus, it is difficult to standardize the amount of expenditure according to specific beneficiaries as in the case of school expenses. Therefore, in this paper, we focus on school expenses that account for the lion's share of local educational expenditure.

Next we overview the expenditure data classified by the components. According to the "Local Educational Expense Survey," educational expenditures by local governments can be classified into three categories: current expenditure composed mainly of payroll expenses; capital spending incurred mainly for fixed assets such as school buildings; and local government debt redemption expenses. Since it is reasonable to think that the amount of debt redemption expense is unlikely to reflect a voter's preference, we decide to analyze current and capital expenditures instead.

In FY2017, the total amount of current and capital expenditure is JPY275 billion for kindergartens, JPY 5,606 billion for primary schools, JPY3,197 billion for junior high schools, and JPY2,525 billion for high schools, making primary schools the largest recipient of funding. Looking at the time-series trend from FY1979 (the earliest survey year available online) at each educational stage, the amount of educational expenditure had been increasing since the 1980s. The growth rate slowed at the dawn of the 1990s and was generally flat during that decade. After that, in the 2000s, kindergarten and primary schools showed a slightly decreasing trend, while junior high schools seemed to be nearly flat. As for high school, a decreasing trend is identified, but some portion of it (after 2014) showed an increasing trend.

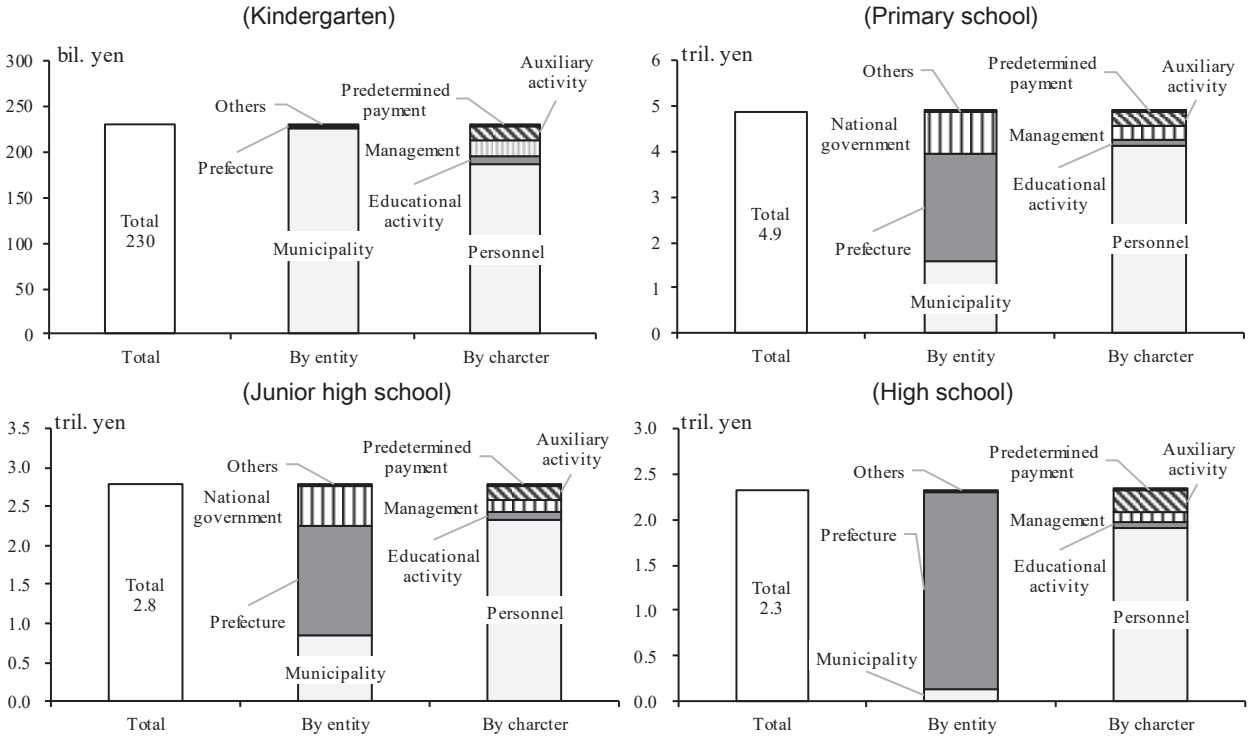


(Source) “Local Educational Expense Survey”, “School Basic Survey.”

Fig.2：Public educational expenditures

Educational expenditures per student in FY2017 is JPY1.02 million for kindergartens, JPY0.89 million for primary schools, JPY1.04 million for junior high schools, and JPY0.77 million for high schools, making junior high school the largest recipient. As for the number of students, the trend has clearly increased during the period of the second generation of baby boomers' children. Since then, however, it has continued to decline until now. On the other hand, educational expenditure per student had been steadily increasing until the 1990s in all educational stages, implying that schoolroom educational costs per student has been increasing even while the number of children has been decreasing. In the 2000s, the trend showed a slight increase or was substantially flat; only kindergarten expenses per child started to increase again, at least after 2006.

Fig.3 shows the breakdown of current expenditure by financing entity and character. Accordingly, almost 80% of the total amount is payroll expense at all educational stages. The other 20% are the costs required for classroom operations, i.e., "educational activities expense" such as education-related consumable materials, special activities, and business trips, along with "management expense," e.g., repairs, security, purchases of consumable supplies, heating, and lighting costs.



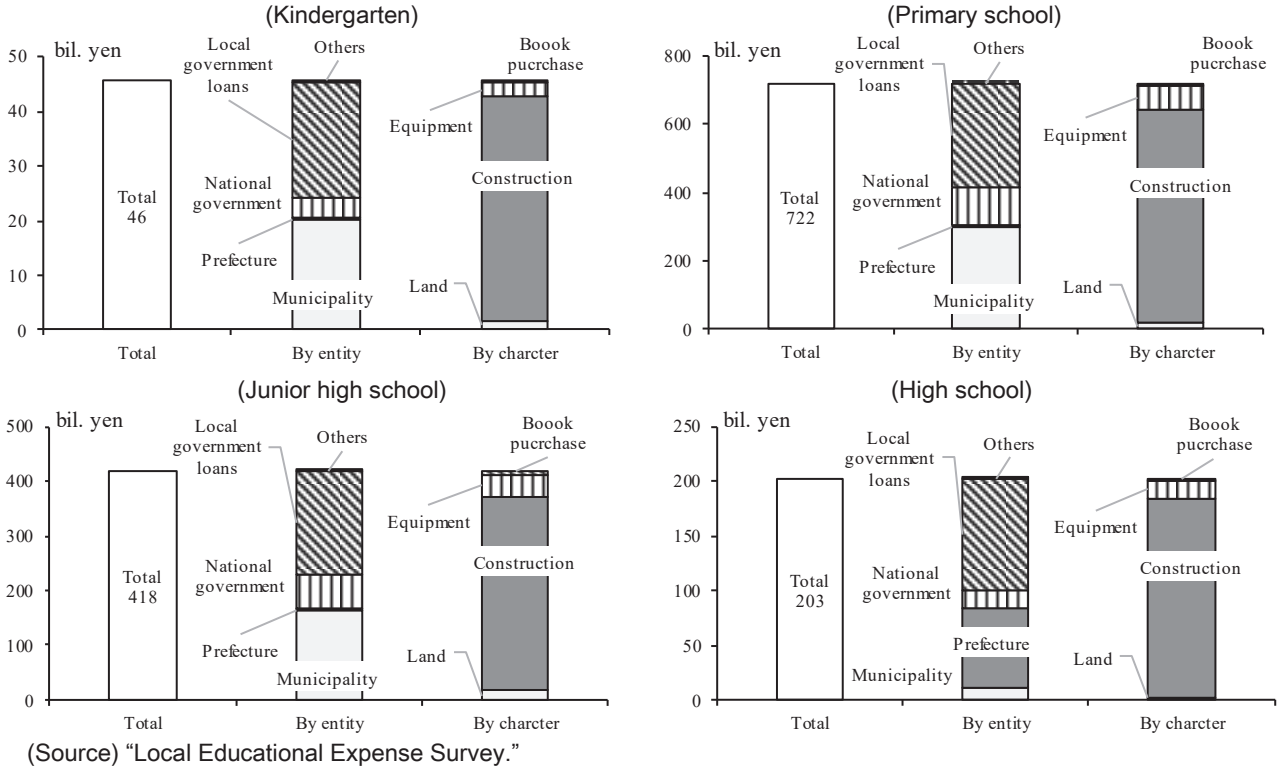
(Source) "Local Educational Expense Survey."

Fig.3：Breakdown of current expenses (FY2017)

Next, we investigate the main financing entities for each stage of education. Kindergarten and high school have been established and supervised by municipal boards of education and prefecture boards of education. Therefore, basically, a kindergarten's finance falls under the responsibility of municipalities, while financing high schools falls under the responsibility of prefectures. As for primary and junior high schools, although they are established and supervised by municipal boards of education, both prefectures and municipalities finance their budgets. But as Fig.3 shows, the share of prefectures is higher than that of municipalities. This is because prefecture boards of education have authority to appoint teachers and other staff, and prefectures are in charge of paying their salaries.

In principle, school-related expenditures are supposed to be financed by municipalities, as specified in the Act on Sharing of Salaries for Personnel of Municipal Schools. However, to avoid the possible problem of disparity in educational levels between regions, due to dramatic differences in relative financial strength, prefectures whose financial power is less heterogeneous than a municipality takes responsibility of paying personnel expenses, which is called the Prefectural Subsidies for Teachers' Compensation System. Thus, the burden of current expenditure by a prefecture is larger than that by the municipality at the primary and junior high school levels. Furthermore, under the system of the National Treasury's Sharing of Compulsory Education Expenses, the national government bears one-third of teacher and staff salaries, and prefectures bear the other two-thirds, which is also financed by the national government through LAT to the appropriate prefectures. Unlike primary and junior high school stages, national government subsidies for kindergartens and high schools accounts for only about 1% of total local school expenditures. In recent years, however, aligned with the growing demand to support students with special needs at each educational stage, the national government subsidizes a certain portion of costs for local governments that try to develop a favorable support system.

Now we consider capital expenditure in detail. Fig.4 shows the breakdown of capital expenditure by financing entity and character. As indicated, "construction expense" occupies the largest share of total expenditures, e.g., the cost for extension or reconstruction of school buildings, gymnasiums, and libraries; labor costs for remodeling, material costs, and contracting costs. According to the "Local Educational Expense Survey," projects like large-scale repairs subject to national subsidies or local bond issuance, e.g., construction for disaster recovery and earthquake resistance, expanding the operational life of facilities, and projects that increase the value of facilities are regarded as capital expenditures.



(Source) "Local Educational Expense Survey."

Fig.4：Breakdown of capital expenses (FY2017)

According to the Ministry of Education, Culture, Sports, Science and Technology[1], on April 1, 2017, 98.8% of public primary and junior high schools had completed earthquake-resistant reinforcement of their buildings. In more recent years, it is required to allocate the budget for improvement in educational environment to meet with changes in social situations, e.g., maintenance of aging buildings, equipping structures with air-conditioners, and installing barrier-free facilities.

Pertaining to the financing entities, the share allocated to municipalities is larger than that of prefectures for kindergarten, primary, and junior high schools, since municipal boards of education have a responsibility to establish and supervise schools. Similarly, high schools are established and supervised by prefecture boards of education; prefectures have a larger share than that of a municipality. Compared to current expenditures, the share of local governments' burden is not so large: nearly 50% of total capital expenditures. The other 50% consists of national subsidies and local bonds issued; and the share of local bonds issued accounts for about 40% for all educational stages. To provide an equal educational opportunity and improve country-wide educational levels, the national government covers a maximum one-half of capital expenses for public school facilities, especially for compulsory educational stages. Variance exists among educational levels, although national government subsidy accounts for nearly 20% in primary and junior high schools, it amounts to only 5% for high schools.

Some previous research that investigated the relationship between aging and public educational expenditure with long-term time-series data showed that the relationship was not always constant through an estimation period and pointed out the possibility of structural changes during the covered periods. For example, Hoxby (1998) showed that aging and educational expenditures were positively correlated in the beginning of the Twentieth Century, but since then that positive impact has declined and eventually became negative in the 1990s. In Japan, Ohtake and Sano (2009), examined the relationship between aging and compulsory education expenditures using a prefectural level panel dataset during the period 1975 to 2005 statistically identified that the influence of aging on expenditure changed around 1993. They found a positive relationship before 1985, but negative after 1990. Miyaki and Kimura (2019) also statistically tested for structural breaks and divided the estimation periods into two phases, considering fiscal reforms concerning the intergovernmental relationships.[2] As a result, the significant negative influence of aging on educational expenditure is more prominent in the latter phase of the estimation period than in the earlier phase, especially for lower educational stages Table 2. As for high school and university stages, the positive impact of aging on educational expenditure seems to have diminished during the latter phase of the period.

[1] Refer to the website of the Ministry of Education, Culture, Sports, Science and Technology (http://www.mext.go.jp/a_menu/shotou/zyosei/nyuumon.htm)

[2] For primary and junior high school, they consider a FY2004 fiscal reform introducing a new block-grant system toward the government subsidy for compulsory education and a FY2006 revision of the national treasury's obligatory share of compulsory education expenses. For universities they consider FY2004 fiscal reform of turning into independent administrative corporations and apply chow-tests to the data. As for kindergarten and high school stages, since there have not experienced any huge reform deserving special mention and due to some data constraint problems, they apply Supremum-Wald Test that is applicable to the data even when the period of structural change is not specified beforehand.

Table 2: Impact of aging by educational stage: the evidence from Miyaki and Kimura(2019)

Educational stage	Kindergarten		Primary school		Junior high school		High school		University	
Period	～1996	1997～	～2004	2005～	～2002	2003～	～2000	2001～	～2003	2004～
Static model	(－)	－－	－－－	(－)	(－)	－－－	(－)	(－)	＋	(－)
Dynamic model	(＋)	－－	－－	－－－*	(＋)	－－－	＋＋＋	(＋)*	＋	(－)

(Note1) + and - indicate positive and negative sign of coefficients of estimated parameters, respectively.
(Note2) Parentheses indicate "not significant". + (or -), ++ (or --) and +++ (or ---) indicate each coefficient is significant at 10%, 5% and 1%, respectively.
(Note3) * indicates that Hansen-J statistic shows some instrument variables might not be exogenous.
(Note4) Dynamic model applies Arellano Bond model.
(Source) Miyaki and Kimura (2019).

Based on the results of Ohtake and Sano (2009), it seems that the elderly evidence a rather passive attitude toward educational expenditures after 1990s they used to be. More precisely according to the greater detailed analysis by Miyaki and Kimura (2019), the elderly negatively support spendings in kindergarten, primary school, junior high school, high school and university after 1997, 2005, 2003, 2001 and 2004, respectively (Table 2). Thus, in this paper, we focused on the latter phase of the estimation period in Miyaki and Kimura (2019), and at each stage, we explored what specific components of educational expenditures the elderly were "unwilling" to support. This is important for policy making, so that one may grasp recent trends in the elderly's preferences. The estimation period is from 1997 to 2014 for kindergarten, from 2005 to 2014 for primary schools, from 2003 to 2014 for junior high schools, and from 2001 to 2014 for high schools. We did not examine university education, since we cannot obtain university expenditure data by character due to data constraints.

4. The analysis

4.1: Estimation model

First, we conduct a statistical test to check the stationarity of the independent and dependent variables. Specifically, we apply the LLC test (Levin, Lin and Chu, 2002) and the IPS test (Im, Pesaran and Shin, 2003) to the data, along with the Fisher-type test (Maddala and Wu, 1999) to unbalanced panel data. To ascertain the difference among those tests, we consider an AR(1) model as follows. Here *i* indicates prefecture and *t* indicates time. In all the tests, null hypothesis is that there is a unit root.

$$y_{it} = \alpha_i + \gamma_i t + \rho_i y_{it-1} + \varepsilon_{it}$$

The LLC test assumes that a variable takes the same value for all prefectures both in the null and the alternative hypotheses, and that $\rho_i < 1$ in the alternative hypothesis,

H0: $\rho_i = 1$ for all i $(i = 1, 2, \dots, 47)$

H1: $\rho_i < 1$ for all i $(i = 1, 2, \dots, 47)$

On the other hand, the IPS test loses the assumption of the alternative hypothesis that ρ_i is the same among all *i*. The value of ρ_i can be varied among each *i*, assuming $\rho_i < 1$ at least in one prefecture.

H0: $\rho_i = 1$ for all i $(i = 1, 2, \dots, 47)$

H1: $\rho_i < 1$ for i $(i = 1, 2, \dots, N)$, $\rho_i = 1$ for i $(N, N+1, N+2, \dots, 47)$

Finally, a Fisher-type test has the same assumptions as an IPS test, but it applies a unit root test (ADF test or

Phillips-Perron test) to the individual *i*. The null hypothesis is examined using test statistics calculated by tallying up the obtained *p*-values. We confirmed that all the variables become stationary after taking the first difference.

The analysis in this paper is based on the following model.

$$y_{i,t} = \rho y_{i,t-1} + \beta pop65_{i,t} + X_{i,t}\boldsymbol{\delta} + \gamma YEAR_t + \alpha_i + u_{i,t}$$

Here $y_{i,t}$ indicates the educational expenditure (current expenditure or capital expenditure) per student enrolled at each educational stage in *i* prefecture for fiscal year *t*. To analyze the amount of educational expenditure over which local governments have discretion, we subtracted the amount of national subsidy per student from current and capital expenditure per student spent by prefectures and municipalities and set them as dependent variables.

The local governments' present behavior would be more or less dependent on the behavior taken in the past. $y_{i,t-1}$ is the lagged dependent variable which considers this dynamic behavior of the local government. If the behavior of local public bodies was dynamic and the lag term of the dependent variable was not taken into account, the error term would be correlated with the dependent variable and the estimation results would be biased. Thus, dynamic models that consider past expenditure should be included in the first step of the analysis and, therefore, in this paper we applied dynamic panel analysis.

Many previous studies suggested the dynamic behavior of government expenditure. Potrafke (2010) analyzed the relationship between state government expenditure allocation and government ideology in West Germany, applying a dynamic panel model for its robustness check. Kappeler and Välilä (2008) pointed out that the fiscal expenditure as dependent variable has strong autocorrelation. Jia et al. (2014) analyzed the influence of the decentralization progress of local governments on local fiscal expenditure, using a dynamic model to consider heterogeneity of local governments and adhesion to government expenditure. Dahlberg and Johansson (2000) analyzed municipal expenditures and revenue in Sweden, and found the one-year lagged dynamic behavior within the local public sector. Bergström, et al. (2004) also pointed out the importance of considering such behavior by the local government. Takahashi (2013), replicating Dahlberg and Johansson (2000) also pointed out that past expenditure affected current spending. In Japan, Akai, et al. (2003) suggested the possibility of soft budget constraints existing in the LAT system. Miyazaki (2007) pointed out that previous expenditure affected the correction factor in the process of LAT calculation, and under such circumstances local governments anticipate future national government relief in determining their current expenditure. In other words, past expenditures may affect present expenditure, and it is necessary to consider the dynamic behavior of the local governments.

$pop65_{i,t}$ indicates the ratio of population aged 65 and older, and β is the estimated parameter. To deal with the possible endogeneity problem of the aging ratio, we considered the five-year lagged aging ratio as an instrument variable which is a real value obtainable from National Census. $X_{i,t}$ indicates the other independent variables that affect educational expenditures such as the ratio of the potential demander at each educational stage to the total population,[3] the national subsidy per student, the number of schools in each educational stage, per capita income, and a financial capability indicator. The data for per capita income and the financial capability indicator represent the regional economy's level and the local governments' financial situations, respectively. And $\boldsymbol{\delta}$ is the vector of the estimated parameter. $YEAR_t$ indicates a trend term that eliminates the influence of

[3] We calculated the number of the potential demander for each educational stage as follow. We can obtain one-year age data from the national census surveyed in every five years. We can also obtain five-year age group data every year from the National Institute of Population and Social Security. When the national census was taken, we calculate the division ratio of the age group that corresponds to the potential demander of each educational stage. Then, assuming that the division ratio will be constant until the next census, we calculate the potential number of demander using the ratio.

macroeconomic shock on educational expenditures, α_i indicates unobservable heterogeneity of prefectures unchanged over time, and $u_{i,t}$ indicates a stochastic error term. All variables are logarithmically transformed. Note that price data is deflated using the GDP deflator and transformed into its natural logarithm. As for descriptive statistics of the variables, refer to Table 3.

Table 3: Descriptive statistics

(Kindergarten) < FY1997 ~ 2014 >

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per child	846	yen	681,855	159,800	338,905	1,486,413
Capital expenditure per child	846	yen	64,062	70,879	877	725,066
Independent variable						
National government disbursement per child (Current)	846	yen	5,658	21,960	0	352,975
National government disbursement per child (Capital)	846	yen	9,382	15,814	0	162,119
Ratio of a population aged 3 to 5	846	%	2.69	0.27	1.94	3.96
Ratio of a population aged 65 and older	846	%	22.12	3.87	11.04	32.69
Number of public kindergaten	846		117	105	2	560
Income per population	846	yen	2,797,896	481,541	1,901,008	5,431,468
Financial capability indicator	846		0.46	0.20	0.20	1.41

(Primary school) < FY2005 ~ 2014 >

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per pupil	470	yen	665,737	89,972	469,494	944,719
Capital expenditure per pupil	470	yen	89,249	36,134	20,522	240,978
Independent variable						
National government disbursement per pupil (Current)	470	yen	163,471	25,942	104,390	266,068
National government disbursement per pupil (Capital)	470	yen	32,754	20,906	4,230	117,180
Ratio of a population aged 6 to 11	470	%	5.47	0.41	4.41	7.47
Ratio of a population aged 65 and older	470	%	24.29	2.98	15.91	32.69
Number of public primary school	470		463	279	134	1,401
Income per population	470	yen	2,896,047	485,385	2,011,684	5,431,468
Financial capability indicator	470		0.48	0.20	0.21	1.41

(Junior high school) < FY2003 ~ 2014 >

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per student	564	yen	707,673	110,611	468,648	1,140,962
Capital expenditure per student	564	yen	108,535	53,231	18,954	438,279
Independent variable						
National government disbursement per student (Current)	564	yen	201,317	39,356	130,006	414,974
National government disbursement per student (Capital)	564	yen	36,709	26,860	124	219,820
Ratio of a population aged 12 to 14	564	%	2.88	0.21	2.21	3.97
Ratio of a population aged 65 and older	564	%	23.73	3.18	15.04	32.69
Number of public primary school	564		214	137	60	724
Income per population	564	yen	2,873,287	487,256	2,004,735	5,431,468
Financial capability indicator	564		0.47	0.20	0.20	1.41

(High school) < FY2001 ~ 2014 >

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per student	658	yen	737,450	110,136	440,080	1,040,681
Capital expenditure per student	658	yen	74,715	46,841	9,956	355,034
Independent variable						
National government disbursement per student (Current)	658	yen	1,331	5,021	0	65,716
National government disbursement per student (Capital)	658	yen	9,123	17,237	0	139,183
Ratio of a population aged 15 to 17	658	%	3.16	0.36	2.22	4.63
Ratio of a population aged 65 and older	658	%	23.21	3.38	13.70	32.69
Number of public high school	658		83	51	24	282
Income per population	658	yen	2,842,341	487,858	1,982,184	5,431,468
Financial capability indicator	658		0.46	0.20	0.20	1.41

As mentioned before, when the first difference of each variable is taken, the null hypothesis is rejected at the 1% significance level, and stationary data is obtained. In this chapter we estimate the following model. The individual effect α_i is eliminated in this difference model,

$$\Delta y_{i,t} = \rho \Delta y_{i,t-1} + \beta \Delta pop65_{i,t} + \Delta X_{i,t}\boldsymbol{\delta} + \gamma YEAR_t + \Delta u_{i,t}$$

Since the logarithm difference is taken, the above equation captures movement in the rate of change. However, as $\Delta y_{i,t-1}$ and $\Delta u_{i,t}$ are correlated with each other, the consistency of the estimator is satisfied neither in the normal fixed-effect model nor the generalized least squares model. In order to solve this problem, we use an estimation method based on first difference generalized momentum method (GMM) (Arellano and Bond <1991>, hereinafter call A-B model).

As another dynamic model, Anderson and Hsiao (1982)'s two-step least squares method (hereinafter called the A-H model) may be cited, but there are advantages and disadvantages of using this method depending on the characteristics of the sample size. The A-H model calculates a consistent estimator by instrumental variables, thus providing a consistent estimator for the GMM. According to Takahashi (2013), in studies with a sufficiently large cross-sectional data and sufficiently small time-series data, the GMM estimator in the A-B model is more effective than the estimator under a two stage least squares method of the A-H model. In the A-B model, the GMM objective function is defined by using the following moment condition, with an unknown parameter estimated by instrumental variables satisfying $y_{is}, s \leq t-2$.

$$E\left[y_{i,s}\Delta u_{i,t}\right] = 0, t = 2, \ldots, T, s = 0, \ldots, t-2$$
$$E\left[\Delta x_{i,s}\Delta u_{i,t}\right] = 0, t = 2, \ldots, T, s = 1, \ldots, T$$

According to Binder, Hsiao and Pesaran (2005); and Hsiao, Pesaran and Tahmiscioglu (2002), the increase of the lag period as instrumental variables in the GMM estimation could lead to finding a more effective estimator, but imposing too many orthogonal conditions yields problems; and empirically, downward bias also increases. The term of our analysis data is at least ten years, even in the primary school dataset (which has the shortest period), and if the lag period(s) of $y_{is}, s \leq t-2$ as an instrumental variable is not specified, the number of instrumental variables becomes very large. Empirically, it is desirable that the number of instrumental variables is smaller than the number of cross-section individuals. Therefore, in this paper, we consider a higher order lag period additionally when the two lags of the endogenous variable are taken as the instrumental variable (s = 2) and they do not satisfy the orthogonal condition of the instrumental variable.

In both models, obtaining a consistent estimator without serial correlation in the error term is an important assumption underlying GMM estimation. Thus in this paper, we test serial correlation against the error term of the first difference. If the first-order autocorrelation is significant and the second-order autocorrelation is not significant, the original error term is uncorrelated.

4.2: Estimation results and interpretation

Detailed results of estimations and tests are shown in the reference table, while a brief version summarizing the effects of aging is shown in Table 4. We also show the estimation results of the static model for reference which does not consider the lagged dependent variable. Note that we solve the possible endogeneity problem of the aging ratio in the static model, too.

Table 4: Estimation results (A brief version)

Educational stage	Kindergarten		Primary school		Junior high school		High school	
Character	Current	Capital	Current	Capital	Current	Capital	Current	Capital
Static model	(−)	(−)	(+)	(+)	−	(−)	(+)	(+)
Dynamic model	−−	(−)	−−−	(+)	−−−	+	−	+

(Note1) + and - indicate positive and negative sign of coefficients of estimated parameters, respectively.
(Note2) Parentheses indicate "not significant". + (or -), ++ (or --) and +++ (or ---) indicate each coefficient is significant at 10%, 5% and 1%, respectively.
(Note3) Dynamic model applies Arellano Bond model.

Hereafter, we mainly discuss the results obtained through the dynamic model that incorporates the dynamic behavior of local governments. According to Miyaki and Kimura (2019), aging showed a negative and significant correlation with educational expenditures of kindergarten, primary, and junior high schools in the covered period, as shown in Table 2. As a result of the estimations by character conducted in this paper, current expenditures were found to be negatively correlated with aging in all of the estimates. As for high schools, although estimates using the total amount of expenditures were insignificant in Miyaki and Kimura (2019), through estimations by character, current expenditures showed a negative and significant relationship with aging as well as with the results obtained at other educational stages. Based on the foregoing results, a recent trend can be identified that the elderly are not likely to support an increase in current expenditures wherein personnel costs constitute a considerable fraction, at any educational level. The effect of aging on capital expenditure was not statistically significant at the kindergarten and primary school stages; however, it was a positive and significant for junior high and high school, which came out with the opposite result through the estimates of current expenditure. One might point out that an aging population supports such capital expenditure, which consists of construction costs mostly. The coefficient obtained from the estimation at primary schools was also positive, although the result was not statistically significant.

Pertaining to the results of other independent variables: Lagged educational expenditure turned out to be positive and significant in general, which suggested possible dynamic behavior of local governments. In greater detail, current expenditure showed a positive coefficient at the 1% significance level for primary, junior high, and high schools, while capital expenditure showed a positive coefficient at the 1% significance level at kindergarten and high school levels, being 10% significant but still positive at the primary school level, and insignificant at the junior high school one. The national subsidy showed different results depending on the character of the expenditure. Specifically, its effect on the current expenditure was negative and significant for primary, junior high, and high schools, while its effect on capital expenditure was positive and significant at kindergarten, primary, and junior high schools. The national subsidy is hypothesized to positively correlate with local expenditure, since it is a grant that the national government provides to local municipalities in order to encourage them to implement specific administrative projects. Despite the above-mentioned original purpose, national subsidies were found to have a negative relationship with current expenditures.

We attribute the results of the primary and junior high school cases to the fiscal relationship between the national government and prefectures on personnel cost that constitutes a considerable fraction of current expenditures. When a prefecture is driven to reduce the number of teachers and staff, or their salaries (due to fiscal constraint) and as a consequence the amount spent on payroll falls below the base amount mandated by the national government, it will receive the reduced amount of the national subsidy that covers one-third of total personnel

costs. But the remaining two-thirds is the amount distributed through the LAT in the general-purpose budget. Hence, when the prefecture in question spends more on other education-related expenditures than payroll in excess of the reduced payroll for teaching staffs, a negative relationship between the national subsidy granted and the local governments' current expenditures was observed.

Another possible channel of the national subsidy's negative impact on current expenditures might be related to a recent movement in the financing entity at the primary and junior high school stages. In FY2003, a new system wherein municipalities may employ teachers and staffs with their own general budgets was introduced as a trial in designated structural reform districts. Since the Act on Sharing of Salaries for Personnel of Municipal Schools was amended in FY2006, this system has applied to all Japanese municipalities. By increasing municipal discretion, the number of teachers and other staff hired with a municipality's own financial resources has been increasing. Kawakami (2015) conducted a detailed survey about the structure of teachers and staff in public primary and junior high school in the Saga prefecture, and found that the appointment of teachers and staffs by municipalities—i.e., part-time teachers, morals tutors, and school staff for students with special needs and food service operations has been on the rise. Thus, even when a prefecture reduces salaries which leads to reducing the national subsidy, municipalities may employ teachers and staffs complementally with their own financial resources to sustain and improve the quality of education. As a result, local governments' total amount available for current expenditure is boosted. This kind of employment by municipal governments on their own would be affected, for example, by the fiscal treatment under them. That is, toward the employment of school staffs in charge of special support education, local governments' fiscal treatment regarding the recruitment of assistant staff for special support education began for kindergarten in FY 2009, for primary and junior high schools in FY 2007, and for high schools in FY 2011.

The number of schools was not statistically significant except for the capital expenditure for kindergarten and the current expenditure for high schools. The potential number of demanders had statistically significant and positive coefficients for current expenditures on primary and junior high schools and, on capital expenditures for junior high and high schools, while no economies of scale could be confirmed when estimations were conducted by character. Per capita income was positive and statistically significant except for current expenditures for preschools. Hence, educational expenditures in the municipalities with robust economic conditions have a high tendency to be increased regardless of the purpose.

The financial capability indicator showed mixed results for the different educational stages in Miyaki and Kimura (2019), with positive and significant coefficients for current expenditure and, negative and significant coefficients on capital expenditure given estimations by character. As Auchi (2016) pointed out[4], the recent trend is for municipalities that are rich in financial resources to employ part-time teachers, proactively utilizing the expanded discretion of local governments as explained above. Although the result that financially rich municipalities would increase their current expenditures was presumed, it could have been influenced by the administration reform of the incorporation of national universities in FY 2004. The salary of local public officers used to be similar to national public officers due to a stipulation in the Special Act for Education Personnel (Act No. 1 of 1949). This stipulation, however, has been removed since teaching staff found in national schools became nonpublic officers in conjunction with the incorporation of national universities, making the salaries of the teaching staffs of public schools came determined through prefectural ordinances (according to Article 13 of the Special

[4] He points out that one of the characteristics of municipalities which employ part time teachers with their own financial resource is high financial capability indicator.

Act for Education Personnel). After this change, personnel costs, which constitute 80 % of current expenditure, were more influenced by the fiscal situation of local governments.

5. Conclusion

Japan's rapidly aging population has been increasing its share of qualified voters and its influence in political decision-making process. Thus, it is increasingly important to consider the allocation of government expenditures by investigating the preferences of the elderly population with respect to government expenditures. This paper investigated the effect of population aging on local public educational expenditures by conducting a dynamic panel estimation focusing on educational stages and characteristics of expenditures, so as to provide administrative staff in local governments with helpful information when they discuss how to allocate the limited financial resources designated for public education.

According to the estimation results, after the latter half of the 1990s, the elderly population would not support an increase in current expenditures for every educational stage from kindergarten to high school. This result highlights the preferences of the elderly population that restrain expenditures for consumption purposes including payroll. When policy makers try to increase current expenses such as payrolls in order to improve educational quality, even more careful explanation might be needed to understand the elderly whose influence in the political decision-making process has been increasing. A decrease in educational expenditures, especially in payroll, might lead to the deterioration in educational quality over the long run. However, local governments do not just decrease payroll costs when looking at the contents of current expenditure. As we stated earlier, local municipalities have been gradually given discretion over the employment types of teaching staffs; thus financially rich cities, villages, and townships would deal with the deterioration problem on their own by employing part-time teaching staffs or other school staff members.

On the other hand, the elderly population would support capital expenditures for junior high and high school stages after the latter half of the 1990s. This result suggests the elderly mainly support construction expenses resulting in tangible infrastructures. Based on capitalization theory, such infrastructures appreciate asset value which might lead to the elderly's positive attitude toward capital expenditure. But it is important to note that construction expenses have changed from construction, expansion, and renovation of buildings, through reinforcement of buildings against earthquakes, to installment of air-conditioners and barrier-free facilities etc., in response to recent needs for improvement of educational environments.

This study performs an analysis assuming the validity of the median voter theory, which has been employed in previous studies such as Poterba (1997, 1998) and Hoxby (1998). In the United States, it is reasonable to build an analytical model using the median voter theory since it adopts a decentralized system to decide local educational expenditures. In Japan, however, although local education boards are responsible for the administrative affairs of education in terms of political neutrality and stability, financial authority to accomplish effective and balanced municipal operations belongs to the governor. Therefore, the council decides all local governmental expenditures, including educational expenses. This situation implies that applying the median voter theory to an analysis of local educational expenditures in Japan might be inadequate. Previous studies have empirically demonstrated the validity of the median voter theory for total governmental expenditures (Doi, 2000) or for each item of local government expenses (Nagamine and Okui, 1999; Takahashi and Miyamoto, 2014) in Japan. However, no previous

investigation has been performed regarding educational expenditures; this remains an issue to be solved in the future.

Although this study only covered public educational expenditures due to data limitations, in future research we will discuss what a society-wide optimum might look like in terms of educational expenditure, by conducting a comprehensive analysis that utilizes private educational expenditures, including subsidies to private schools, as well as household expenditure. Besides, in this study we are implicitly assuming that elderly are uniform but to be precise, they differ vastly in terms of education, income, wealth, etc. We also need to take behaviors of different groups of the elderly into account to investigate the impact of aging on public expenditures.

Reference Table：Estimation result

Kindergarten

Model Character	Static Current	Static Capital	Arellano - Bond Current	Arellano - Bond Capital
Ratio of a population aged 65 and older	-0.439	-7.035	-0.757 **	-0.691
	(0.315)	(4.390)	(0.320)	(2.097)
Kindergarten expenditure per child (t-1)			0.158	0.263 ***
			(0.177)	(0.047)
National government disbursement per child	0.009 ***	0.358 ***	0.008	0.404 ***
	(0.003)	(0.024)	(0.005)	(0.030)
Number of public kindergaten	0.004	1.936 ***	-0.02	1.527 **
	(0.054)	(0.421)	(0.069)	(0.683)
Ratio of a population aged 3 to 5	-0.378 **	1.629	-0.243	-2.208
	(0.182)	(2.601)	(0.329)	(1.671)
Financial capability indicator	0.090 **	-1.308 **	0.086 **	-0.795 **
	(0.045)	(0.645)	(0.037)	(0.313)
Income per population	0.067	1.924 **	0.001	2.855 ***
	(0.066)	(0.796)	(0.078)	(0.736)
Year	0.000	0.012 **	0.036 ***	0.004
	(0.000)	(0.005)	(0.009)	(0.073)
Constant term	0.158	-23.86 **		
	(0.833)	(10.65)		
Obs.	846	842	846	840
R-squared	0.052	0.322		
Kleibergen-Paap rk LM statistic	119.924 ***	121.184 ***		
Test of AR(1)			-2.29 ***	-5.27 ***
Test of AR(2)			0.67	0.41
Hansen J statistic (p-value)	just identified	just identified	0.988	0.995

Primary school

Model Character	Static Current	Static Capital	Arellano - Bond Current	Arellano - Bond Capital
Ratio of a population aged 65 and older	0.119	2.783	-0.714 ***	1.130
	(0.260)	(1.981)	(0.129)	(0.738)
Kindergarten expenditure per pupil (t-1)			0.364 ***	0.131 *
			(0.052)	(0.066)
National government disbursement per pupil	-0.121 ***	0.350 ***	-0.190 ***	0.345 ***
	(0.022)	(0.024)	(0.022)	(0.035)
Number of public primary school	-0.042	(0.047)	0.057	0.138
	(0.118)	(0.762)	(0.098)	(0.474)
Ratio of a population aged 6 to 11	0.438 ***	0.622	0.647 ***	-0.792
	(0.153)	(1.081)	(0.157)	(0.865)
Financial capability indicator	-0.060	-1.100 ***	(0.038)	-1.322 ***
	(0.052)	(0.391)	(0.044)	(0.185)
Income per population	0.360 ***	0.754 **	0.301 ***	1.399 ***
	(0.049)	(0.319)	(0.056)	(0.227)
Year	-0.005 ***	0.010	0.030 ***	-0.011
	(0.001)	(0.006)	(0.003)	(0.025)
Constant term	11.030 ***	-21.85		
	(2.268)	(13.51)		
Obs.	470	470	470	470
R-squared	0.438	0.360		
Kleibergen-Paap rk LM statistic	50.141 ***	50.763 ***		
Test of AR(1)			-3.51 ***	-4.85 ***
Test of AR(2)			0.96	0.72
Hansen J statistic (p-value)	just identified	just identified	0.331	0.196

Junior high school

Model Character	Static Current	Static Capital	Arellano - Bond Current	Arellano - Bond Capital
Ratio of a population aged 65 and older	-0.390 *	-0.163	-0.804 ***	1.421 *
	(0.219)	(2.043)	(0.151)	(0.833)
Junior high school expenditure per student (t-1)			0.459 ***	0.069
			(0.063)	(0.054)
National government disbursement per student	-0.179 ***	0.335 ***	-0.277 ***	0.336 ***
	(0.026)	(0.023)	(0.023)	(0.026)
Number of public junior high school	0.173	1.637	0.132	0.649
	(0.135)	(1.108)	(0.161)	(1.093)
Ratio of a population aged 12 to 14	0.164 ***	0.461	0.103 *	0.839 *
	(0.050)	(0.471)	(0.057)	(0.444)
Financial capability indicator	0.020	-0.206	-0.040	-1.063 ***
	(0.039)	(0.384)	(0.047)	(0.210)
Income per population	0.352 ***	0.547	0.364 ***	1.003 ***
	(0.046)	(0.361)	(0.052)	(0.334)
Year	-0.004 ***	0.015 ***	0.023 ***	0.001
	0.000	(0.004)	(0.004)	(0.021)
Constant term	8.834 ***	-31.40 ***		
	(1.286)	(8.794)		
Obs.	564	564	564	564
R-squared	0.488	0.326		
Kleibergen-Paap rk LM statistic	71.711 ***	66.868 ***		
Test of AR(1)			-4.47 ***	-4.22 ***
Test of AR(2)			2.07	1.19
Hansen J statistic (p-value)	just identified	just identified	0.413	0.461

High school

Model Character	Static Current	Static Capital	Arellano - Bond Current	Arellano - Bond Capital
Ratio of a population aged 65 and older	0.174	3.176	-0.157 *	2.935 *
	(0.194)	(2.730)	(0.086)	(1.503)
High school expenses per student (t-1)			0.484 ***	0.227 ***
			(0.055)	(0.077)
National government disbursement per student	-0.005 *	0.0168	-0.008 *	0.029
	(0.002)	(0.020)	(0.004)	(0.027)
Number of public high school	0.147 ***	0.862	0.196 ***	0.808
	(0.050)	(0.738)	(0.059)	(0.616)
Ratio of a population aged 15 to 17	0.156 ***	0.876	-0.016	1.300 ***
	(0.046)	(0.605)	(0.034)	(0.470)
Financial capability indicator	0.111 ***	-0.518	0.116 ***	-0.482
	(0.030)	(0.402)	(0.023)	(0.331)
Income per population	0.197 ***	0.839	0.322 ***	1.151 **
	(0.043)	(0.529)	(0.045)	(0.472)
Year	-0.002 ***	0.006	0.006 ***	(0.040)
	0.000	(0.004)	(0.002)	(0.036)
Constant term	4.040 ***	-12.41		
	(0.761)	(9.245)		
Obs.	658	658	658	658
R-squared	0.133	0.032		
Kleibergen-Paap rk LM statistic	93.889 ***	89.62 ***		
Test of AR(1)			-4.09 **	-4.9 ***
Test of AR(2)			-0.07 *	0.83
Hansen J statistic (p-value)	just identified	just identified	0.791	0.902

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